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ABSTRACT

This literature review examined the relationship between the type of mathematics courses taken and scholastic mathematics achievement. The paper concludes that there is a high correlation between types of mathematics courses taken and scholastic math achievement. Specifically, higher level mathematics courses enhance and foster analytical thinking and problem solving ability among students. Consequently, students who have been enrolled in upper level math courses have traditionally scored higher on national tests. The learning resulting from high school through college preparatory math courses enhance a student's success rate in college. Nine references are listed. (YP)

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The Influence of Higher Level Mathematics Courses on the Results of the ACT: A Review of the Literature

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The influence of higher level mathematics courses on the results of the ACT: A Review of the Literature.

By Phyllis L. Tandy

For approximately the last twenty-five or more years, colleges and universities have utilized the SAT/ACT test scores of students as one of the criteria for entrance into post-secondary education. These national tests act as an educational barometer by which to judge mathematical abilities related to cognitive, analytical skills, and prior knowledge.

Secondly, high school scholars are identified and recognized by the Illinois State Scholars' Program via their national test scores. This can subsequently result in future scholarship offers by other organizations and institutions. Consequently, there is a need for parents, teachers, counselors, and administrators to encourage and direct students who have mathematical potential into the most challenging courses of the curriculum. Ultimately our high schools can provide the experience and foundation for future scientists and mathematicians.

Be that as it may, the review of literature and the information from the data does reinforce the fact that students who take higher level mathematical courses will generally score higher on the SAT/ACT tests. As stated from the ACT Assessment Test Preparation Reference Manual, "the most important prerequisite for optimum performance by students on the ACT tests is a sound, comprehensive, educational program." There is still a need for more research in relationship to the type of mathematical courses taken and scholastic math achievement.

Among many school reform reports published since the 1980s, several specific suggestions have been made regarding mathematics. Since the test scores of the SAT/ACT have been declining consistently, some recommendations have been made to respond to the declining scores. The following suggestions were made concerning problems in mathematics education in grades 7-12:

1. Many students lack the math background to succeed on jobs, in universities, or in daily affairs.
2. Students do not have enough experience with problems that require some thought before answering.
3. Many students terminate math study early, not realizing the importance of math in later schooling, especially if at a later time the SAT/ACT is to be taken.

Recommendations have been made to upgrade students by increasing graduation requirements and by improving students' problem-solving performance and their skills in arithmetic and algebra (Usiskin, 1986/1987).

In a review of sex differences, Maccoby and Jackin (1973) concluded that male students consistently outperformed female students on math tests (Smith and Walker, 1988). It has been found that junior high students of high ability that are males consistently outperform females on the SAT/ACT tests. A study done with students in 1973 entering as freshmen at the University of California at Berkeley, it was found that 43% of the male students and 92% of the female students lacked a second year of algebra and the precalculus background necessary for the standard freshman calculus sequence (Smith and Walker,

1988). More recent data indicates increased female participation in upper level high school mathematics courses.

In general secondary school students seem to have reasonably good procedural knowledge in areas of math as rational numbers, probability, measurement, data organization and interpretation (Brown, 1988). It seems that students are lacking conceptual knowledge that enables them to successfully do application problems, problem solving, and reasoning items on tests such as the SAT/ACT. It has been noted that the best preparation came from a continued and extensive reading and study program, and from selecting courses that emphasize communication and mathematical skills.

A curriculum that fits today's recommendations should begin in grade seven with algebra for those students who seem to be above average and conclude at grade eight with algebra for those students who seem to be average. This therefore spreads out the learning of traditional subject matter dealing with math so that students have enough time to complete math courses without rushing through the material. This plan seems workable for those students who are average or slightly below average to have room for newer content in math.

Standard secondary school curriculum normally includes algebra, geometry, advanced algebra, analytical geometry, trigonometry, elementary functions, and calculus. The trend for the late 1980s is for eighth grade students to take algebra to make it easier for those students to take Advanced Placement calculus in twelfth grade who are considered average or above. Updating

curriculum is a topic that is being discussed more and more and attention is being given to statistics and probability and to discrete mathematics. These topics are not being suggested as enrichment but are considered the basics of a good education in mathematics (Ususkin, 1987).

The literature indicated that students needing remedial mathematics when they enter colleges and universities are at serious risks. Approximately one-third of students who enter colleges and universities with remedial math placement actually graduate (Waits and Demana, 1988). Many professionals recommend three years of college preparatory math for students intending to enter college. Many students are unable to participate in major programs of study because they lack mathematical skills (Waits and Demana, 1988).

In 1986, a mathematics assessment on algebra, and geometry was conducted. The assessment contained approximately fifty-six items measuring ability in algebraic expressions and variables. In geometry, the assessment contained approximately forty-eight geometric items. If an item could be solved visually, the student's performance was better than if it required more abstract thinking (Brown, 1988).

With variables and algebraic expressions, about one-fourth of the students with no algebra successfully answered items requiring simplification. Students with one year of algebra answered the items somewhat successfully. Two year algebra students answered quite successfully.

Students who had no geometry performed poorly on items that involved formal knowledge of properties or applications. Students who had geometry performed much better on the test, approximately seventy-five per cent better.

For items on the test covering logical reasoning, those students who had three years of college preparatory math did far better than those students who had one year of algebra or less.

Students' performances on some test items was clearly related to their course background. The results of the assessment given as compared to past assessments indicated a need for more math courses to be taken. Students often are not able to apply this knowledge in problem solving situations, nor do they appear to understand many of the structures underlying those mathematical concepts and skills (Brown, 1988).

Most educators realize that math skills taught in high school are extremely important for a certain amount of success in college or a university. Students who lack the skills usually taught in college preparatory curriculum believe they can pick them up in their first year of college and are not aware of the possible lasting negative consequences regarding graduation and career choices (Waits and Demana, 1988).

An achievement test given to precalculus and calculus students indicated that the calculus classes made very large gains in elementary functions and calculus. The posttest scores of the precalculus classes were below the pretest scores of the calculus classes. The precalculus classes never reached a

comparable level. Further analysis does indicate that a lot of the decline comes from poorer performance on items requiring higher cognitive skills rather than on items requiring computational skills (Travers and McKnight, 1985). In the last twenty years a modest gain in achievement has taken place for the college bound math student. It is indicated that much of the gain stems from items at higher cognitive levels of comprehension and application rather than computational skills.

Since all students are not college bound, there is a need to increase the amount of math courses taken in high school. Data indicated that most high schools desire to increase the amount of courses taken for those students who are college bound. Data from the Second IEA Mathematics Study indicated that most students have not reached the level of achievement needed to deal effectively with college level calculus.

In 1980, a relationship was found between senior math achievement test scores and the number of math courses taken at the level of Algebra 1 and above. An accepted fundamental assumption in education is that schooling improves a student's skills and knowledge. Courses in reading, writing, and arithmetic are supposed to enhance the mastery of these subjects (Jones, 1986). Recent evidence does show a strong relation between math skill and the number or types of math courses taken in high school.

An influence on math test scores of taking certain math courses in high school might be due to the tendency for brighter students to select the type of courses that they do. A definite influence on test scores of taking certain courses that are more advanced certainly depends on the fact that students who take

more are skilled in these subjects. The research found that students who had taken a small number of courses scored low on many of the items. Data did indicate that students who took a larger number of courses in advanced math displayed higher test scores than those who only took a smaller number of courses. The average math test score was higher due to the type or number of math courses taken. The difference in the average test score between students who did not take as many advanced topics in math and those who did was greater than two standard deviations of test scores (Jones, 1986).

In summary, the review of literature indicated that there is a high correlation between types of mathematics courses taken in conjunction to scholastic math achievement. Specifically, higher level mathematics courses enhance and foster analytical thinking and problem solving ability among students. Consequently, students who have been enrolled in upper level math courses have traditionally scored higher on national tests such as the ACT/SAT. Subsequently, the foundation and experience from high school via these college preparatory math courses have enhanced a student's success rate in college. As was mentioned and implied throughout the literature, educational practitioners must continue to encourage students to enroll in upper level math courses as per their abilities and potential.

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